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System Logic Description for Pretreatment Facility Cs Ion Exchange Process (CXP) System

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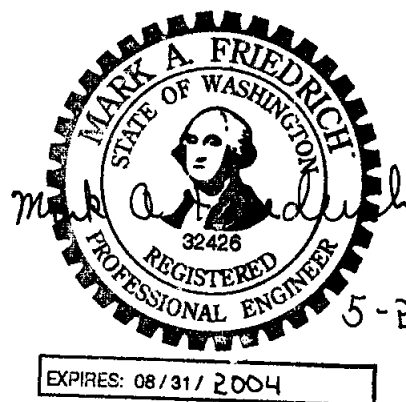
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Acronyms and Abbreviations

AI	Analog input
CNP	Cesium Nitric Acid Recovery Process System
CXP	Cesium Ion Exchange Process System
DI	Discrete input
HLP	HLW Lag Storage and Feed Blending Process System
IX	Ion exchange
LAH	Level alarm high
LAHH	Level alarm high high
LI	Level indication
LOL	Lower operating limit
LP	Low pressure
LSH	Level switch high
LSHH	Level switch high-high
LT	Level transmitter
P&ID	Piping and instrumentation diagram
PT	Pretreatment
PWD	Plant Wash & Disposal
RDP	Spent Resin Collection and Dewatering Process System
UFP	Ultrafiltration Process System
UOL	Upper operating limit
WTP	River Protection Project - Waste Treatment Plant

Glossary

acquire	Acquire is a command under a batch control that reserves a group of equipment for that particular batch control operation.
batch	The material that is being produced or that has been produced by a single execution of a batch process.
batch control	This term refers to control activities and control functions that provide an ordered set of processing activities to complete a batch process.
batch process	The production of a finite quantity of material by subjecting quantities of input material to an ordered set of processing activities over a finite period of time using one or more pieces of equipment.
control system	Electronic Processors that perform regulatory and logic control functions necessary for plant normal operation.
exception handling	Those functions that deal with plant or process contingencies and other Logic events, which occur outside the normal or desired behavior of batch control.
interlock	This term refers to a mechanism that automatically brings about or prevents the operation of another mechanism.
lower operating limit	A vessel low-level set point used to stop a transfer-out batch operation from the vessel under normal plant operations.
permissive	Interlock which allows a device to change state or a sequence to start. Once a device has changed state or a sequence started, a permissive has no further effect on the device or sequence.
release	A command under a batch control, that opens up a group of equipment for any batch control to acquire.
trip	A trip is a conditional interlock that forces a device or a sequence to a defined state. A trip continues to have an effect on the device or sequence until the interlock condition no longer exist.
upper operating limit	A vessel high-level setpoint used to stop a transfer-in batch operation to the vessel under normal plant operation.

1 Introduction

This document describes the instrument control logic for tank and ancillary equipment for the Cs Ion Exchange Process System (CXP) within the pretreatment (PT) facility that are associated with dangerous waste management.

2 Applicable Documents

24590-WTP-M6-50-P0001, *P&ID Symbols and Legend Sheet 1 of 6*
24590-WTP-M6-50-P0002, *P&ID Symbols and Legend Sheet 2 of 6*
24590-WTP-M6-50-P0003, *P&ID Symbols and Legend Sheet 3 of 6*
24590-WTP-M6-50-P0004, *P&ID Symbols and Legend Sheet 4 of 6*
24590-WTP-M6-50-P0005, *P&ID Symbols and Legend Sheet 5 of 6*
24590-WTP-M6-50-P0006, *P&ID Symbols and Legend Sheet 6 of 6*
24590-PTF-M6-CXP-P0001, *P&ID - PTF Cesium Ion Exchange Process Vessels System*
24590-PTF-M6-CXP-P0002, *P&ID - PTF Cesium Ion Exchange Columns System*
24590-PTF-M6-CXP-P0003, *P&ID - PTF Cesium Ion Exchange Columns System*
24590-PTF-M6-CXP-P0005, *P&ID - PTF Cesium Ion Exchange Utility Services - PSA Rack*
24590-PTF-M6-CXP-P0007, *P&ID - PTF Cesium Ion Exchange Utility Services - Plant Wash Rack*
24590-PTF-M6-CXP-P0010, *P&ID - PTF Cesium Ion Exchange Treated LAW Collection Vessels System*
24590-PTF-M6-CXP-P0011, *P&ID - PTF Cesium Ion Exchange Utility Services - PSA Rack*
24590-PTF-M6-CXP-P0012, *P&ID - PTF Cesium Ion Exchange Utility Services - PSA Rack*
24590-PTF-M6-CXP-P0013, *P&ID - PTF Cesium Ion Exchange Utility Services - Plant Wash Rack*

3 Description

The following plant items and ancillary equipment are associated with dangerous waste management within the CXP system, which resides in the PT facility.

- Cs Ion Exchange Feed Vessel (CXP-VSL-00001)
- Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004)
- Cs IX Reagent Vessel (CXP-VSL-00005)
- Cs Ion Exchange Treated LAW Collection Vessels (CXP-VSL-00026A/B/C)
- Cs Ion Exchange Columns (CXP-IXC-00001/2/3/4)
- Cs IX Process Bulge (CXP-BULGE-00004)

The Cs Ion Exchange Columns (CXP-IXC-00001/2/3/4) will not have a level control associated with them and will operate as flooded columns. Process fluids are pumped from the source vessel, through the CXP-IXC-00001/2/3/4 to the destination vessel.

3.1 CXP-VSL-00001

The Cs Ion Exchange Feed Vessel (CXP-VSL-00001) receives batches of LAW feed from the UFP system and provides a continuous feed to the Cs IX columns. CXP-VSL-00001 receives six batches of LAW feed over approximately five days from the UFP system. These six transfers build an inventory of LAW feed in the CXP-VSL-00001, which is used to maintain a continuous feed to the IX columns for six days, allowing the UFP system to operate on a six day cycle feeding the CXP system for 5 days and shutting down one day for cleaning without interrupting feed to the IX columns. CXP-VSL-00001 may also receive recycled LAW from the Cs Ion Exchange Treated LAW Collection Vessels (CXP-VSL-00026A/B/C) if after sampling it is determined that reprocessing of the LAW feed is required and receives displaced LAW feed from the IX columns each regeneration cycle.

Prior to a batch of LAW feed being transferred to CXP-VSL-00001 it is sampled in the UFP system to ensure CXP requirements have been met. Once the sample is confirmed, the operator will initiate the transfer of a batch of LAW feed to the CXP-VSL-00001. Once the sequence is initiated, the control system will verify that instruments, utilities, and equipment associated with the transfer are within operational parameters. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. The transfer is stopped by the control system when any of the following are true:

- The level in the Cs Ion Exchange Feed Vessel (CXP-VSL-00001) reaches its upper operating limit (UOL)
- The level of the UFP vessel reaches its lower operating limit (LOL)

Once LAW feed has been passed through the IX columns to remove Cs to meet LAW vitrification requirements the processed LAW is sampled in the Cs Ion Exchange Treated LAW Collection Vessels (CXP-VSL-00026A/B/C). If the sample determines the LAW feed must be reprocessed to meet LAW glass requirements the batch is recycled to CXP-VSL-00001. The operator will then initiate the transfer of the LAW feed from the Cs Ion Exchange Treated LAW Collection Vessel to CXP-VSL-00001. Once the sequence is initiated, the control system will verify that instruments, utilities, and equipment associated with the transfer are within operational parameters. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. The transfer is stopped by the control system when any of the following are true

- The level in the Cs Ion Exchange Feed Vessel (CXP-VSL-00001) reaches its UOL
- The level of the Cs Ion Exchange Treated LAW Collection Vessel reaches its lower operating limit (LOL)

During regeneration of an IX column the LAW feed is displaced from the column with 0.1M NaOH. The displaced LAW feed is sent to CXP-VSL-00001. This is an operator initiated sequence. Once the sequence is initiated, the control system will verify that instruments, utilities, and equipment associated with the transfer are within operational parameters. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. The transfer is stopped by the control system when any of the following are true

- The level in the Cs Ion Exchange Feed Vessel (CXP-VSL-00001) reaches its UOL
- The target volume of regenerant has been transferred from the IX column to the Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004).

If the level is not within the normal operating range, interlocks along with alarms help prevent an overflow condition. At the high alarm set point, an alarm is generated. At the high-high alarm set point, an alarm is generated and all dedicated controlled feeds are isolated. Isolation occurs by a combination of either stopping the motive force, closing valves, or a combination of these actions. Figure 1, shows the typical interlocks and alarms for the level instruments associated with the Cs Ion Exchange Feed Vessel (CXP-VSL-00001).

3.2 CXP-VSL-00004

The Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004) receives spent regenerant from the Cs IX columns each regeneration cycle. The spent regenerant will then be used as the LAW displacement fluid during the next IX column regeneration cycle. If it is determined that the spent regenerant is not concentrated enough 0.25M NaOH may be added to increase the molarity of the spent regenerant or the spent regenerant may be sent to plant wash.

An operator initiates each step in the CXP system; once the post elution rinse of an IX column is complete the operator will initiate the regeneration sequence for the IX column undergoing regeneration and select the destination for the spent regenerant. If the Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004) is selected for the destination of the spent regenerant the valves are aligned and the transfer initiated. Once the sequence is initiated, the control system will verify that instruments, utilities, and equipment associated with the transfer are within operational parameters. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. The transfer is stopped by the control system when any of the following are true for a respective transfer:

- The level in the Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004) reaches its UOL.
- The target volume of regenerant has been transferred from the IX column to the Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004).

If it is determined that the spent regenerant molarity is not adequate for LAW displacement, 0.25M NaOH is added to the Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004) to increase the molarity of the spent regenerant. Also process condensate may be added to CXP-VSL-00004 for make-up volume or dilution. Transfers of either 0.25M NaOH or process condensate to CXP-VSL-00004 are initiated by an operator. Once the sequence is initiated, the control system will verify that instruments, utilities, and equipment associated with the transfer are within operational parameters. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. The transfer is stopped by the control system when any of the following are true for a respective transfer:

- The level in the Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004) reaches its UOL.
- The target volume of fresh reagent (0.25M NaOH) or process condensate has been transferred to Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004).

If the level is not within the normal operating range, interlocks along with alarms help prevent an overflow condition. At the high alarm set point, an alarm is generated. At the high-high alarm set point, an alarm is generated and all dedicated controlled feeds are isolated. Isolation occurs by a combination of either stopping the motive force, closing valves, or a combination of these actions. Figure 2 shows the interlocks and alarms for the level instrument associated with the Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004).

3.3 CXP-VSL-00005

The Cs IX Reagent Vessel (CXP-VSL-00005) receives 0.1M NaOH, 0.25M NaOH, DIW, and 0.5M nitric acid from the fresh reagent system. CXP-VSL-00005 also receives spent regenerant to be used as displacement fluid from the Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004). For greater waste management reliability, batch controlled transfers into CXP-VSL-00005 are limited by the control system to one transfer in or out at a time by the batch control mechanism of acquiring and releasing.

The fresh reagents sent to CXP-VSL-00005 are used during regeneration, 0.25M NaOH and distilled water are used each time an IX column is regenerated and the 0.5M nitric acid and the 0.1M NaOH are used as off normal sources if the normal source for the respective reagents is unavailable. Each reagent transfer to CXP-VSL-00005 is operator initiated. The level in CXP-VSL-00005 operates on a deadband starting flow to the vessel at low level and stopping flow when a high level is reached. Once the sequence is initiated, the control system will verify that instruments, utilities, and equipment associated with the transfer are within operational parameters. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. The transfer is stopped by the control system when the following is true:

- The target volume of reagent has been transferred to the CXP system to complete the regeneration step of an IX column.

If spent regenerant is used to perform the LAW displacement step of a column regeneration, the fluid is transferred from the Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004) to the Cs IX Reagent Vessel (CXP-VSL-00005) via an RFD. The transfer is initiated by an operator and uses a deadband level control in order to control level in the CXP-VSL-00005, starting flow to the vessel at low level and stopping flow when a high level is reached. Once the sequence is initiated, the control system will verify that instruments, utilities, and equipment associated with the transfer are within operational parameters. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. The transfer is stopped by the control system when one of the following is true

- The target volume of reagent has been transferred to the CXP system to complete the regeneration step of an IX column.
- The level in the Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004) reaches its LOL.

If the level is not within the normal operating range, interlocks along with alarms help prevent an overflow condition. At the high alarm set point, an alarm is generated. At the high-high alarm set point, an alarm is generated and all dedicated controlled feeds are isolated. Isolation occurs by a combination of either stopping the motive force, closing valves, or a combination of these actions. Figure 3 shows the interlocks and alarms for the level instrument associated with the Cs IX Reagent Vessel (CXP-VSL-00005).

3.4 CXP-VSL-00026A/B/C

Cs Ion Exchange Treated LAW Collection Vessels (CXP-VSL-00026A/B/C) operate together to ensure continuous processing of LAW feed occurs. Each vessel operates on a 72-hour cycle where it receives one batch of treated LAW feed from the IX columns over 24 hours, samples the LAW feed to ensure compliance over the next 24 hours, and then discharges the LAW feed to the TLP system over the final 24 hours of the cycle. To ensure continuous processing of LAW feed the vessels operate out of phase; thus, one vessel undergoes filling, while another vessel's contents are sampled, the third vessels contents are discharged.

Prior to a Cs Ion Exchange Treated LAW Collection Vessel the vessel must be in the correct state. The control system will check the state of the vessel to confirm its availability before to a transfer of LAW can take place. Once the vessel state is confirmed a transfer of LAW feed from the Cs IX columns can be initiated. Once the sequence is initiated, the control system will verify that instruments, utilities, and equipment associated with the transfer are within operational parameters. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. The transfer is stopped by the control system when one of the following is true:

- The level in the Cs Ion Exchange Treated LAW Collection Vessel reaches its UOL.

CXP-VSL-00026A/B/C are filled in full batches. However, if breakthrough of an ion exchange column occurs the transfer is stopped, the IX columns are realigned to remove the lead column from the LAW processing train and shift the lag column to the lead position, polish column to the lag position and the regenerated column to the polish position and processing of LAW feed is restarted. The transfer of feed into the Cs Ion Exchange Treated LAW Collection Vessel continues until its UOL is reached.

If the level is not within the normal operating range, interlocks along with alarms help prevent an overflow condition. At the high alarm set point, an alarm is generated. At the high-high alarm set point, an alarm is generated and all dedicated controlled feeds are isolated. Isolation occurs by a combination of either stopping the motive force, closing valves, or a combination of these actions. Figure 4 shows the interlocks and alarms for the level instrument associated with the Cs Ion Exchange Treated LAW Collection Vessels (CXP-VSL-00026A/B/C).

3.5 CXP-IXC-00001/2/3/4

The Cs IX Columns house the resin used to remove Cs-137 from the LAW stream. At any time, three of the four IX columns will be processing LAW feed to support LAW vitrification, and one IX column will undergo regeneration. In all modes the Cs IX columns operate fully flooded and thus do not have level control. The IX columns do have individual rupture disks to protect the Cs IX columns from over pressure. The rupture disks are instrumented to alarm and interlock feeds in the event a disk rupture. Figure 5 shows the interlocks and alarms for the level instrument associated with the Cs IX Columns (CXP-IXC-00001/2/3/4).

3.6 CXP-BULGE-00004

The Cs IX Process Bulge contains valves to direct effluents from the Cs IX columns to CXP-VSL-00004, the Cs IX Caustic Rinse Collection Vessel, and the PWD and RDP systems, and direct fluids received from RDP-PMP-00011, the Spent Resin Dewatering Container Pump. The bulge provides secondary containment and shielding to protect the worker. The Cs IX Process Bulge is instrumented with a level switch to alarm an operator that a leak in the bulge has occurred. Any spilt fluids are drained to the C5 drain collection header. Figure 6 shows the alarm for the level instrument associated with the Cs IX Process Bulge (CXP-BULGE-00004).

Figure 1. Level Measurement for Cs Ion Exchange Feed Vessel (CXP-VSL-00001)

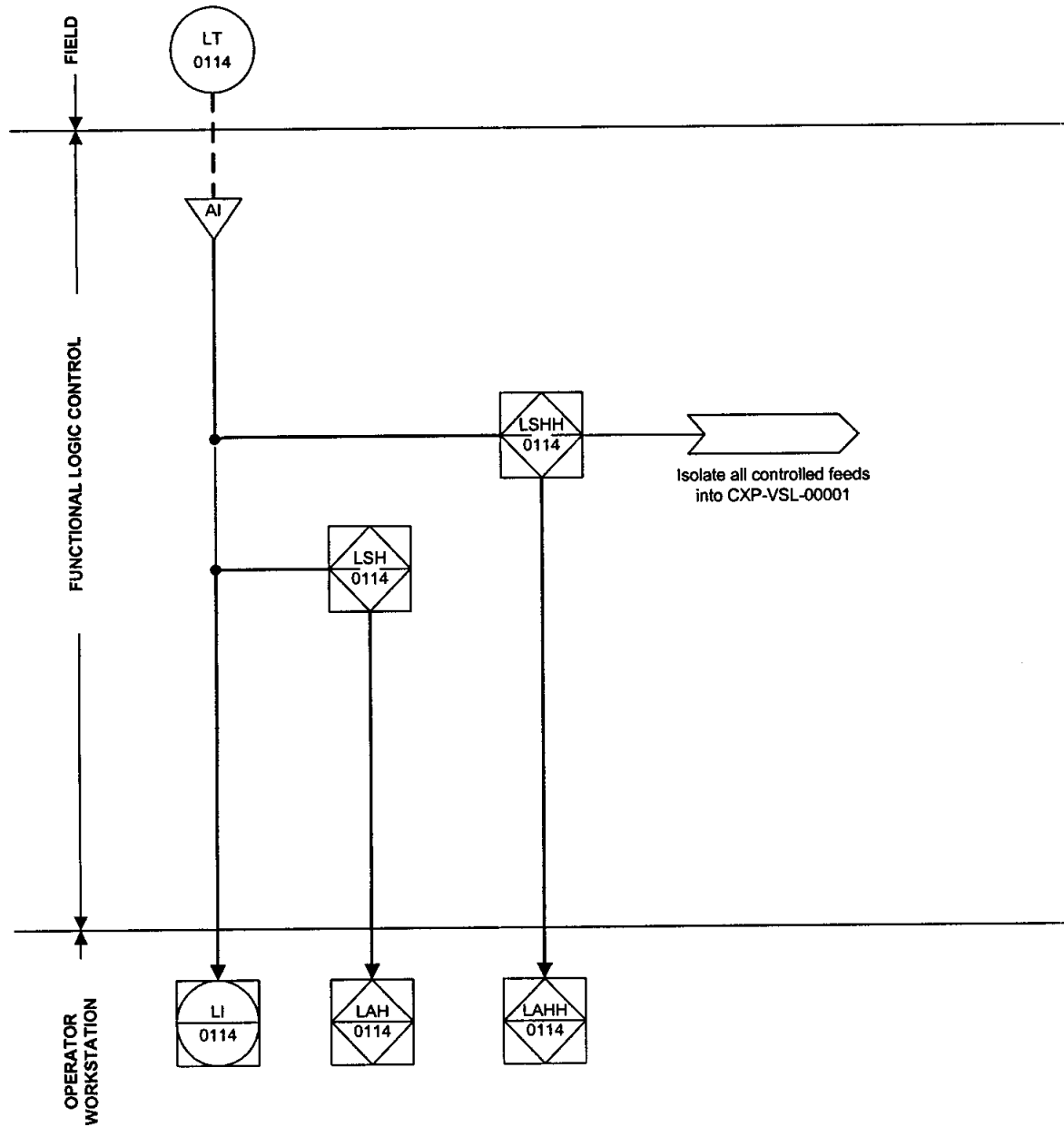


Figure 2. Level Measurement for Cs IX Caustic Rinse Collection Vessel
(CXP-VSL-00004)

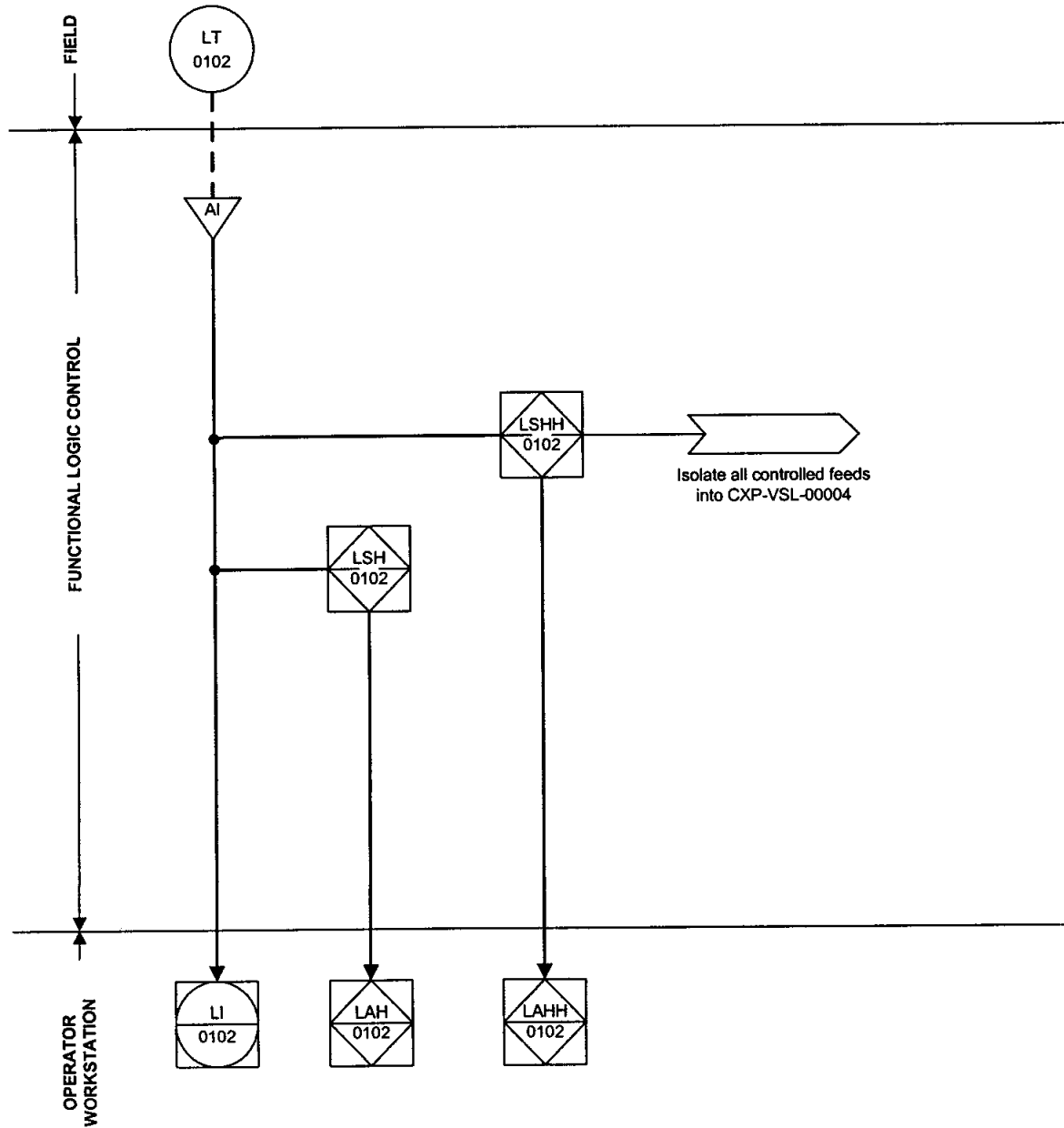


Figure 3. Level Measurement for Cs IX Reagent Vessel (CXP-VSL-00005)

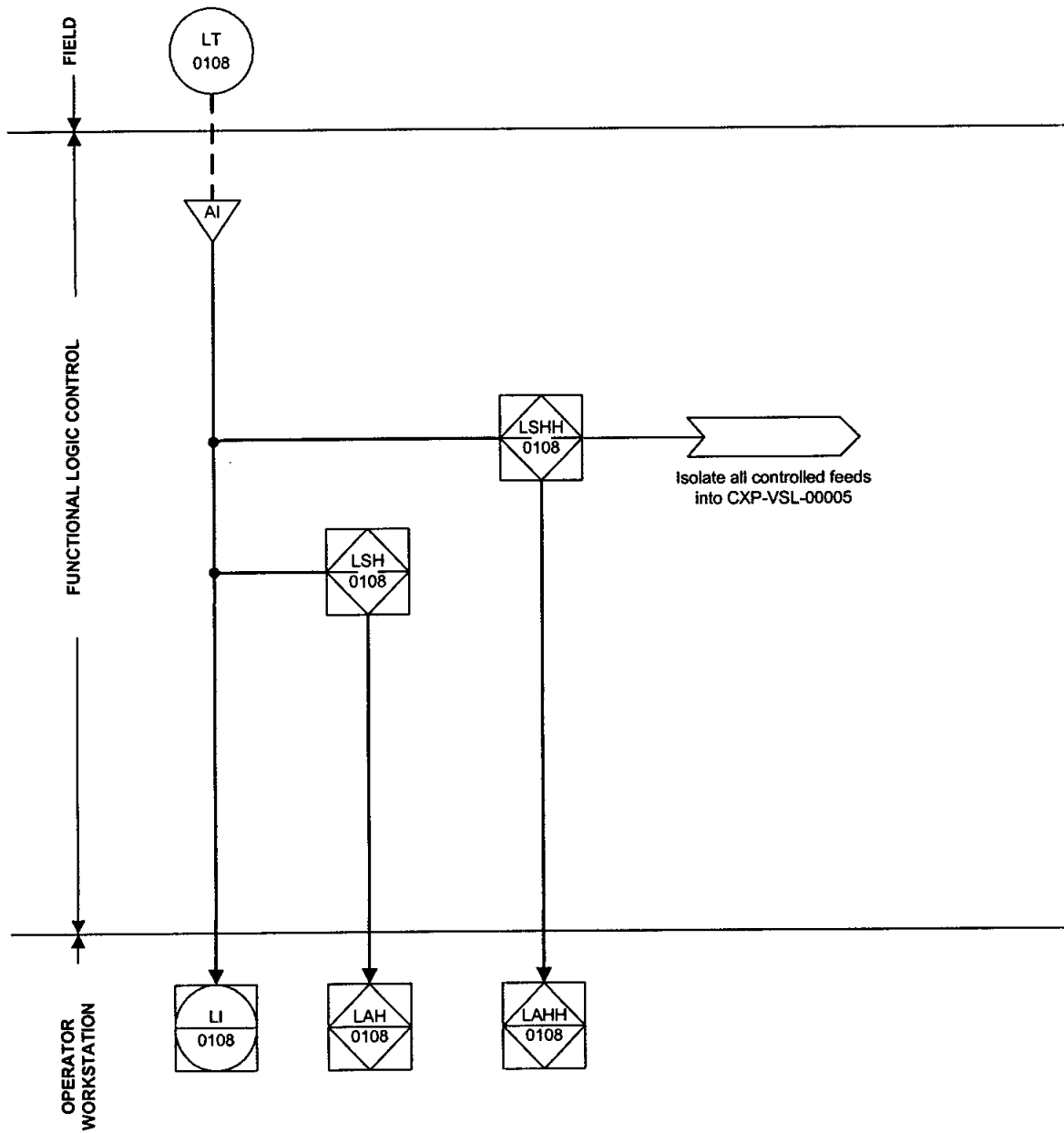


Figure 4. Level Measurement for Cs Ion Exchange Treated LAW Collection Vessel
 (Typical for CXP-VSL-00026A/B/C)

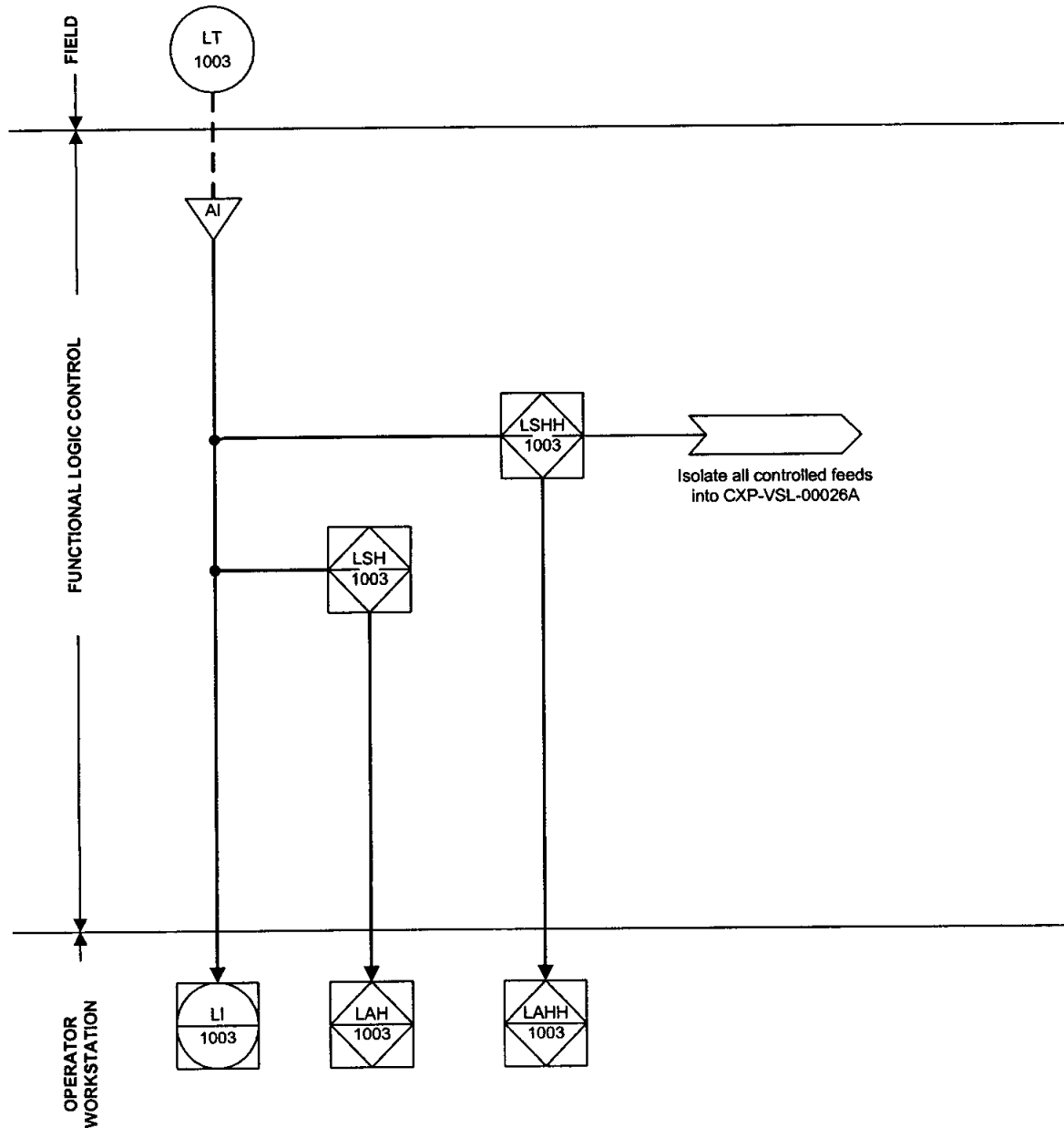


Figure 5. Rupture Disk Indication for Cs IX Columns (Typical CXP-IXC-00001/2/3/4)

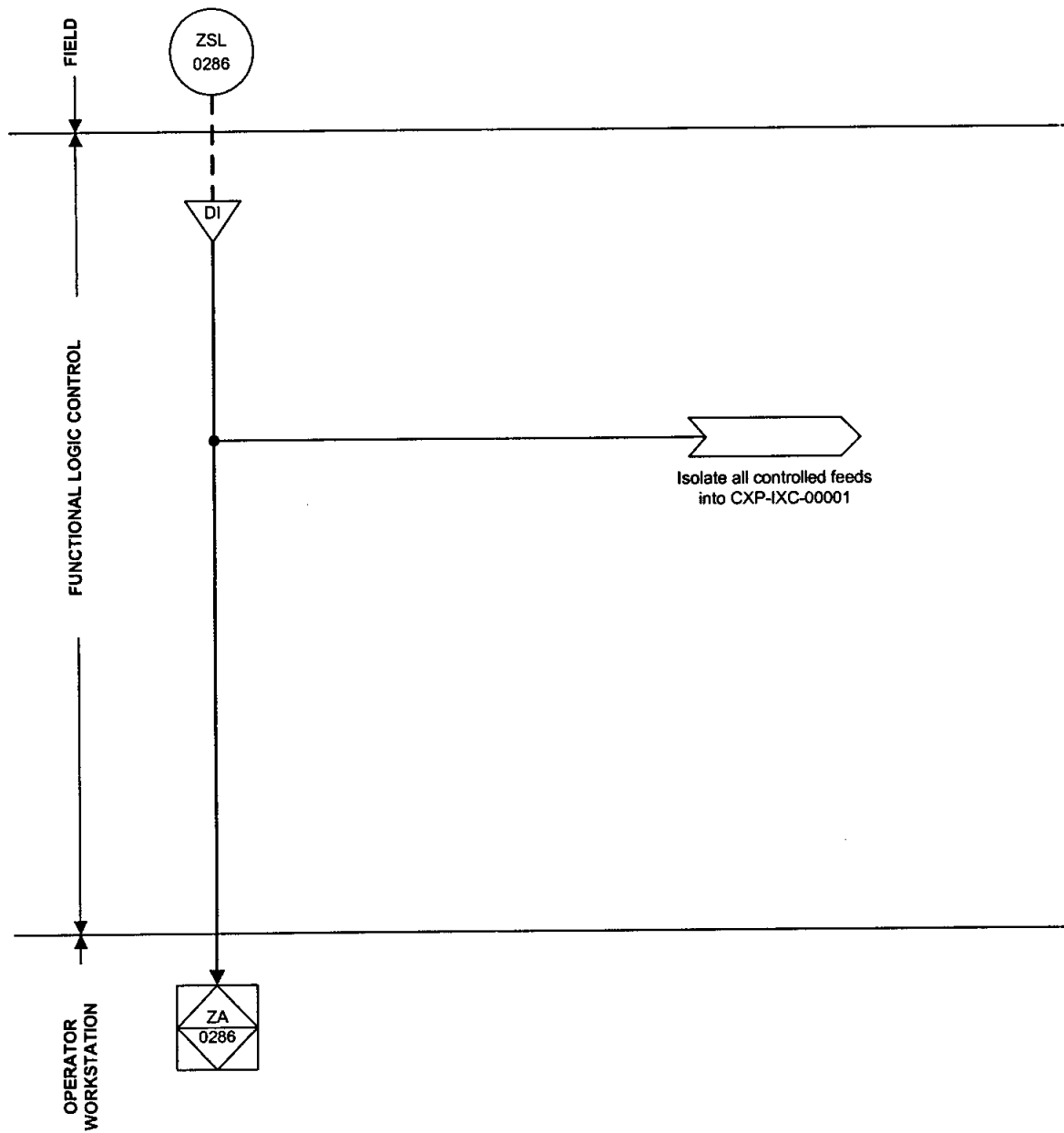


Figure 6. Level Switch for Cs IX Process Bulge (CXP-BULGE-00004)

